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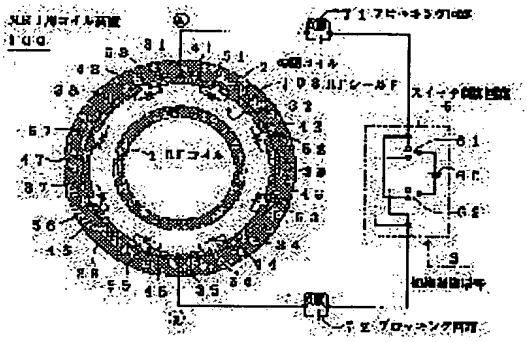
(54) COIL DEVICE FOR MRI

(57)Abstract:

PURPOSE: To attain both RF shield performance and the reduction of an eddy current.

CONSTITUTION: An RF shield 103 is formed in dividing structure consisting of eight pieces of copper foil 31-38, and diodes 41-48 are interposed between the copper foil, and the diodes are controlled by making active by switching the polarity of a DC bias voltage from a switch control circuit 6, and those pieces of copper foil 31-38 are connected together when a RF signal is transmitted and a NMR signal is received, and each divided part is cut off when a gradient magnetic field is changed. In this way, the RF shield performance is improved better than conventional technique to connect each copper foil with a capacitor. Also, the eddy current is reduced smaller than the conventional technique to use the copper foil without a slit or the one to connect the copper foil with the capacitor.



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CLAIMS

[Claim(s)]
[Claim 1] A coil system for MRI equipped with RF shield which is interposed between an RF coil characterized by providing the following, a gradient magnetic field coil prepared in an outside of the RF coil, and said RF coil and said gradient magnetic field coil, and prevents both coupling A switching means which connects or intercepts these division portion while dividing said RF shield into two or more division portions It is the switch control means which said division portion is connected at the time of RF transmission and NMR signal reception, and controls said switching means to intercept said division portion at the time of gradient magnetic field change.
[Claim 2] A coil system for MRI characterized by said switching means containing a diode switch in a coil system for MRI according to claim 1.
[Claim 3] A coil system for MRI characterized by making it flow to reverse sense mutually in a coil system for MRI according to claim 2 in said division portion which a bias current of said diode switch adjoins.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the coil system for MRI which can reconcile improvement in RF (Radio Frequency) shield engine performance, and reduction of an eddy current in more detail about the coil system for MRI (Magnetic Resonance Imaging).
[0002]
[Description of the Prior Art] Drawing 7 is the important section cross section showing an example of the conventional coil system for MRI. This coil system 600 for MRI is equipped with RF coil 1 of the birdcage mold which photos a head etc., the inclination coil 2 prepared in that outside, and the RF shield 603 which comes to stick copper foil that there is no break in the medial surface of that inclination coil 2.
[0003] Drawing 8 is the important section cross section showing the other examples of the conventional coil system for MRI. This coil system 700 for MRI is equipped with RF coil 1, the inclination coil 2 prepared in that outside, the RF shield 103 which vacates the breaks 51-58 for reducing an eddy current for the medial surface of this inclination coil 2, and comes to stick eight copper foil 31-38, and the capacitors 741-748 which connect each copper foil 31-38.
[0004]
[Problem(s) to be Solved by the Invention] Since the copper foil which does not have a break as an RF shield 603 is used, about RF shield engine performance, it excels in the above-mentioned conventional coil system 600 for MRI. However, since the eddy current by the gradient magnetic field tends to flow, there is a trouble which causes the fall (fall of a SURYU rate) of the responsibility of a gradient magnetic field.
[0005] On the other hand, in the above-mentioned conventional coil system 700 for MRI, since the copper foil divided as an RF shield 103 is used, the eddy current by the gradient magnetic field can be reduced. However, although a certain amount of RF shield engine performance is obtained since the divided copper foil is connected in RF with the capacitor, there is a trouble that it is inferior to RF shield engine performance compared with the RF shield 603 which is using copper foil without a break. Especially, with the MRI equipment of a low magnetic field (less than [0.5T]) with a low resonance frequency, if capacity of said capacitor is not enlarged, there is a trouble that RF shield engine performance becomes inadequate. That is, in the conventional coil system for MRI, there is a trouble with it difficult [to reconcile improvement in RF shield engine performance and reduction of an eddy current]. Then, the purpose of this invention is to offer the coil system for MRI which can reconcile improvement in RF shield engine performance, and reduction of an eddy current.
[0006]
[Means for Solving the Problem] A gradient magnetic field coil with which this invention is prepared in an outside of an RF coil and its RF coil, In a coil system for MRI equipped with RF shield which is interposed between said RF coils and said gradient magnetic field coils, and prevents both coupling, while dividing said RF shield into two or more division portions A switching means which connects or intercepts these division portion, A coil system for MRI characterized by establishing a switch control means which controls said switching means to connect said division portion at the time of RF transmission and NMR signal reception, and to intercept said division portion at the time of gradient magnetic field change is offered. In a coil system for MRI of the

above-mentioned configuration, said switching means is a diode switch. Moreover, a bias current of this diode switch constitutes so that it may flow to reverse sense mutually in said adjoining division portion. In addition, a capacitor may be made intermingled if it is about 50% of the connection place of a division portion.

[0007] Moreover, this invention makes RF shield block construction, a switching means is interposed between each division portion, that switching means is actively controlled by switch control means, each division portion is connected at the time of RF transmission and NMR signal reception, and RF shield and an eddy current reduction method in MRI characterized by intercepting each division portion at the time of gradient magnetic field change are offered.

[0008]

[Function] In the coil system for MRI of this invention, RF shield is made into block construction, a switching means is interposed between each division portion, that switching means is actively controlled by the switch control means, each division portion is connected at the time of RF transmission and NMR signal reception, and each division portion was intercepted at the time of gradient magnetic field change. At the time of RF transmission and NMR signal reception, since each division portion is connected by the switching means, RF shield engine performance can be improved rather than the conventional technology which connects each division portion with a capacitor. Moreover, at the time of gradient magnetic field change, since each division portion is intercepted by the switching means, rather than the conventional technology which connects each division portion with a capacitor, separation of each division portion becomes certain and an eddy current can be reduced. That is, improvement in RF shield engine performance and reduction of an eddy current can be reconciled.

[0009] In addition, if a diode switch is used as a switching means, high-speed switching can be performed easily and it is desirable. Moreover, since the bias current of a diode switch flows to the reverse sense mutually in said adjoining division portion, the magnetic field by the bias current can deny mutually, and can suit, and the effect of MRI on the magnetic field by the bias current can be lost.

[0010]

[Example] Hereafter, the example shown in drawing explains this invention in more detail. In addition, thereby, this invention is not limited.

[0011] - The simple perspective diagram of MRI equipment is shown in 1st example- drawing 1 . This MRI equipment M possesses the coil system 100 for MRI containing an RF coil and an inclination coil, and is constituted. Drawing 2 is configuration explanatory drawing showing the coil system for MRI of the 1st example of this invention. This coil system 100 for MRI For example, RF coil 1 of the birdcage mold which photos a head etc., The inclination coil 2 prepared in that outside, and the RF shield 103 which vacates breaks 51-58 for the medial surface of this inclination coil 2 towards coupling becoming small, and comes to stick eight copper foil 31-38, The diodes 41, 42, 43, and 44 which connect each copper foil 31, 32, 33, 34, and 35 to the forward direction in this order, It has the diodes 48, 47, 46, and 45 which connect each copper foil 31, 38, 37, 36, and 35 to the forward direction in this order, and the switch control circuit 6 separated to said copper foil 31 and 35 in [the blocking circuits 71 and 72 connect in direct current, and] RF. Said switch control circuit 6 contains DC power supply 60 and the polar change-over switches 61 and 62 turned off and replaced with the change over control signal S from the control section (illustration abbreviation) of MRI equipment.

[0012] As shown in drawing 3 , two or more diodes 41 are formed in juxtaposition. The juxtaposition pitch of these diodes 41 is sufficiently small compared with the wavelength of RF. For example, in the case of 21MHz (wavelength of 14.3m) frequency of RF, it is about 10cm. The same is said of other diodes 42-48.

[0013] Drawing 4 is explanatory drawing showing the polarity of the direct current voltage impressed to the pulse sequence for MRI, and said change over control signal S and said copper foil 31 and 35. in addition, the pulse sequence for MRI -- here -- SE (Spin Echo) -- it considers as the pulse sequence of law.

[0014] First, in the standup forward section P1 of the slice selection gradient magnetic field Gs, since RF shield and eddy current prevention is also unnecessary, said copper foil 31-38 may be connected,

and you may intercept. That is, the polarity of the direct current voltage impressed to said copper foil 31 and 35 is arbitrary (polar x in drawing expresses arbitration). Therefore, a command or a command of a "reverse bias" of "forward bias" is sufficient as said change over control signal S. In addition, in drawing 4 , it is the command of a "reverse bias."

[0015] Next, in leading edge [of the slice selection gradient magnetic field Gs] A, although RF shield is unnecessary, since there is the necessity for eddy current prevention, said copper foil 31-38 is intercepted. That is, direct current voltage is impressed with the polarity which said copper foil 31 becomes negative and said copper foil 35 just becomes, and the reverse bias of the diodes 41-48 is carried out. Therefore, said change over control signal S becomes the command of a "reverse bias."

[0016] Next, in 90-degree pulse transmitting section B, since RF shield is needed, said copper foil 31-38 is connected. That is, direct current voltage is impressed with the polarity from which said copper foil 31 just consists of, and said copper foil 35 becomes negative, and forward bias of the diodes 41-48 is carried out. Therefore, said change over control signal S becomes the command of "forward bias."

[0017] Next, in falling of the slice selection gradient magnetic field Gs, and the impression section C of the encoding gradient magnetic field germanium, although RF shield is unnecessary, since there is the necessity for eddy current prevention, said copper foil 31-38 is intercepted. That is, direct current voltage is impressed with the polarity which said copper foil 31 becomes negative and said copper foil 35 just becomes, and the reverse bias of the diodes 41-48 is carried out. Therefore, said change over control signal S becomes the command of a "reverse bias."

[0018] In the next section P2, since RF shield and eddy current prevention is also unnecessary, said copper foil 31-38 may be connected, and you may intercept. That is, the polarity of the direct current voltage impressed to said copper foil 31 and 35 is arbitrary. Therefore, a command or a command of a "reverse bias" of "forward bias" is sufficient as said change over control signal S. In addition, in drawing 3 , it is the command of a "reverse bias."

[0019] Next, in leading edge D of the slice selection gradient magnetic field Gs, although RF shield is unnecessary, since there is the necessity for eddy current prevention, said copper foil 31-38 is intercepted. That is, direct current voltage is impressed with the polarity which said copper foil 31 becomes negative and said copper foil 35 just becomes, and the reverse bias of the diodes 41-48 is carried out. Therefore, said change over control signal S becomes the command of a "reverse bias."

[0020] Next, in 180-degree pulse transmitting section E, since RF shield is needed, said copper foil 31-38 is connected. That is, direct current voltage is impressed with the polarity from which said copper foil 31 just consists of, and said copper foil 35 becomes negative, and forward bias of the diodes 41-48 is carried out. Therefore, said change over control signal S becomes the command of "forward bias."

[0021] Next, in last transition [of the slice selection gradient magnetic field Gs] F, although RF shield is unnecessary, since there is the necessity for eddy current prevention, said copper foil 31-38 is intercepted. That is, direct current voltage is impressed with the polarity which said copper foil 31 becomes negative and said copper foil 35 just becomes, and the reverse bias of the diodes 41-48 is carried out. Therefore, said change over control signal S becomes the command of a "reverse bias."

[0022] Next, in the impression section G of a lead gradient magnetic field, since RF shield is needed, said copper foil 31-38 is connected. That is, direct current voltage is impressed with the polarity from which said copper foil 31 just consists of, and said copper foil 35 becomes negative, and forward bias of the diodes 41-48 is carried out. Therefore, said change over control signal S becomes the command of "forward bias." After impression of a lead gradient magnetic field returns to the standup forward section P1 of said slice selection gradient magnetic field Gs.

[0023] According to the above coil system 100 for MRI, since copper foil 31-38 is connected by ON of diodes 41-48, rather than the conventional technology which connects with a capacitor, RF shield engine performance can be improved at the time of RF transmission and NMR signal reception, and it can fully shield RF also with the MRI equipment of the low magnetic field where a resonance frequency is low. Moreover, since copper foil 31-38 is intercepted by OFF of diodes 41-48 at the time of gradient magnetic field change, an eddy current can be reduced.

[0024] In addition, FET, a photo coupler, etc. may be used instead of said diodes 41-48.

[0025] - 2nd example- drawing 5 is configuration explanatory drawing showing the coil system for

MRI of the 2nd example of this invention. RF coil 1 of the birdcage mold which this coil system 200 for MRI is formed in MRI equipment M as shown in drawing 1 , for example, photos a head etc., The inclination coil 2 prepared in that outside, and the RF shield 103 which vacates breaks 51-58 for the medial surface of this inclination coil 2 towards coupling becoming small, and comes to stick eight copper foil 31-38, The capacitor 201 which connects copper foil 31 and 32, and the diodes 42, 43, 44, 45, 46, 47, and 48 which connect each copper foil 32, 33, 34, 35, 36, 37, 38, and 31 to the forward direction in this order, It has the switch control circuit 6 separated to said copper foil 31 and 32 in [the blocking circuits 71 and 72 connect in direct current, and] RF. Said switch control circuit 6 contains DC power supply 60 and the polar change-over switches 61 and 62 turned off and replaced with the change over control signal S from the control section (illustration abbreviation) of MRI equipment. Actuation of this coil system 200 for MRI is the same as that of the above-mentioned example 1.

[0026] According to the above coil system 200 for MRI, although the capacitor 201 is used for connection of copper foil 31 and 32, since others connected the copper foil which adjoins with diodes 42-48, they can acquire the above-mentioned example 1 and the same effect as abbreviation.

[0027] - 3rd example- drawing 6 is configuration explanatory drawing showing the coil system for MRI of the 3rd example of this invention. RF coil 1 of the birdcage mold which this coil system 300 for MRI is formed in MRI equipment M as shown in drawing 1 , for example, photos a head etc., The inclination coil 2 prepared in that outside, and the RF shield 103 which vacates breaks 51-58 for the medial surface of this inclination coil 2 towards coupling becoming small, and comes to stick eight copper foil 31-38, The diode 41 which connects copper foil 31 and 32 to the forward direction in this order, and the diode 42 which connects copper foil 33 and 32 to the forward direction in this order, The diode 43 which connects copper foil 33 and 34 to the forward direction in this order, and the diode 44 which connects copper foil 35 and 34 to the forward direction in this order, The diode 45 which connects copper foil 35 and 36 to the forward direction in this order, and the diode 46 which connects copper foil 37 and 36 to the forward direction in this order, The diode 47 which connects copper foil 37 and 38 to the forward direction in this order, and the diode 48 which connects copper foil 31 and 38 to the forward direction in this order, While dissociating to said copper foil 31, 33, 35, and 37 in [the end side a is connected by the blocking circuit 371,373,375,377 in direct current, and] RF It has the switch control circuit 6 separated to said copper foil 32, 34, 36, and 38 in [the other end side b is connected by the blocking circuit 372,374,376,378 in direct current, and] RF. Said switch control circuit 6 contains DC power supply 60 and the polar change-over switches 61 and 62 switched with the change over control signal S from the control section (illustration abbreviation) of MRI equipment. Actuation of this coil system 300 for MRI is the same as that of the above-mentioned example 1.

[0028] According to the above coil system 300 for MRI, the above-mentioned example 1 and the same effect as abbreviation can be acquired. Furthermore, mutually, for the reverse sense, the magnetic field according [the bias current which flows copper foil 31, 33, 35, and 37, and the bias current which flows copper foil 32, 34 36, and 38] to a bias current can deny mutually, and can suit, and the effect of MRI on the magnetic field by the bias current can be lost.

[0029]

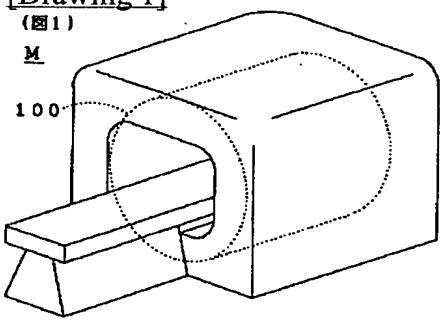
[Effect of the Invention] An RF shield makes into block construction, a switching means interposes between each division portion, that switching means controls actively by the switch control means, each division portion connects at the time of RF transmission and NMR signal reception, and since each division portion intercepted, according to the coil system of this invention for MRI, the RF shield engine performance can improve at the time of gradient-magnetic-field change rather than the conventional technology which connects each division portion with a capacitor. Moreover, an eddy current can be reduced rather than the conventional technology using copper foil without a break, and the conventional technology which connects each division portion with a capacitor.

[Translation done.]

DRAWINGS

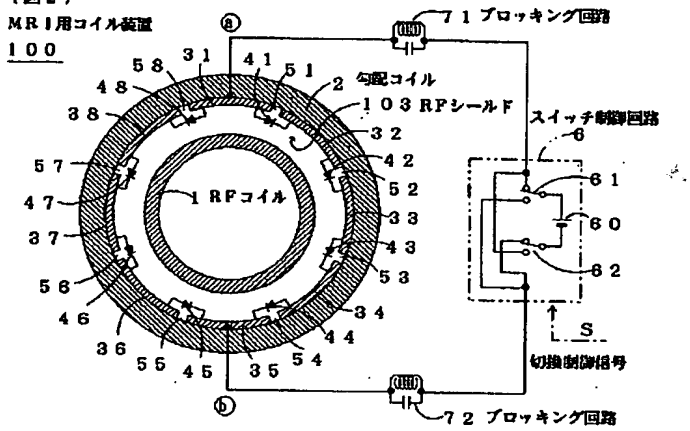
[Drawing 1]

(図1)



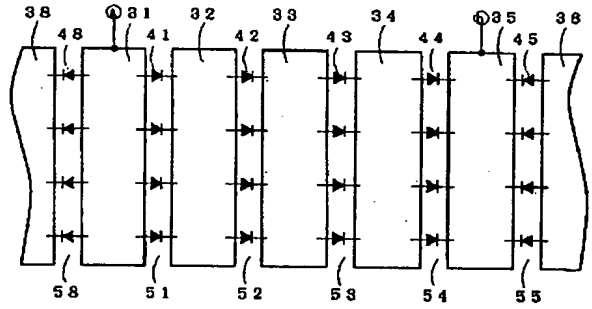
[Drawing 2]

(図2)



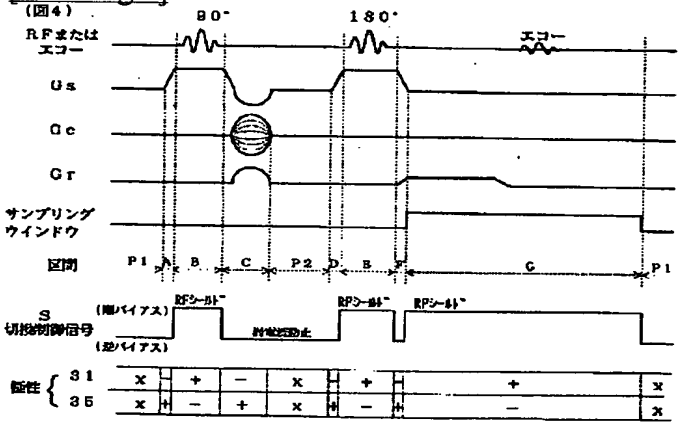
[Drawing 3]

(図3)

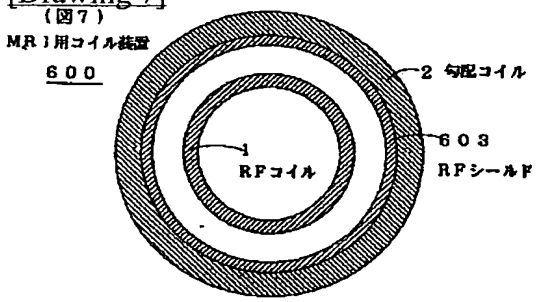


[Drawing 4]

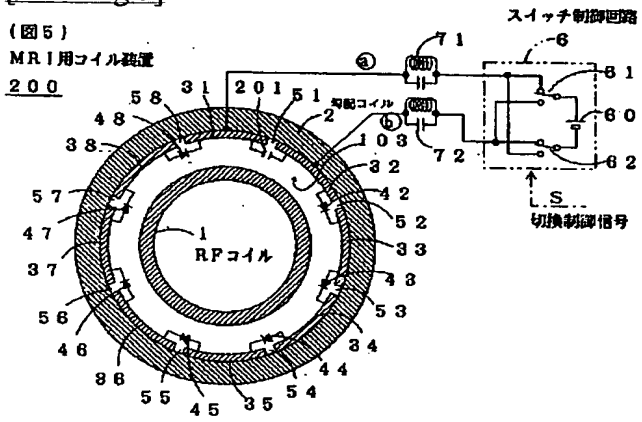
(図4)



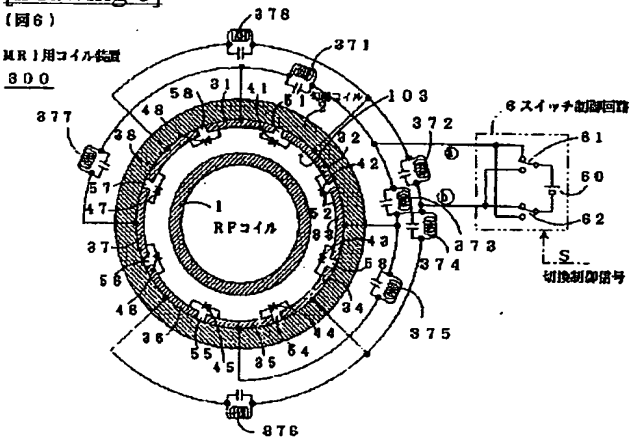
[Drawing 7]



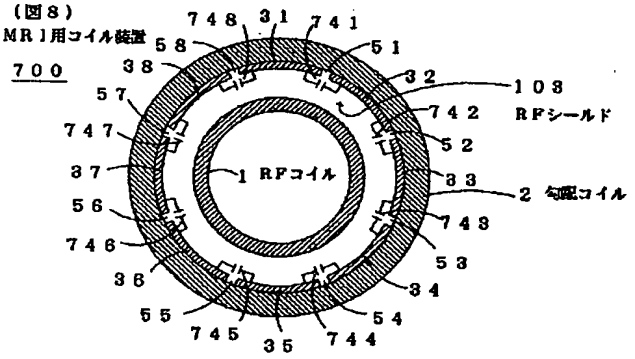
[Drawing 5]



[Drawing 6]



[Drawing 8]



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